many) sides of transactions. A third mechanism employs the match scores to clear the electronic market. In the specific embodiment, the first mechanism includes an administrator interface, which allows an administrator to define the descriptor variables. A configurator communicates with the administrator interface and allows the administrator to assign a first set importance values to corresponding descriptor variables. The first set importance values includes default importance values or importance values assigned to the descriptor variables by a seller seeking to transact with a buyer via the electronic market. The administrator interface allows an administrator to configure a user interface of the market to allow market participants to assign a second set of importance values to different descriptor variables. The second set of importance values includes buyer and seller importance values. The descriptor variables and associated descriptor importance values may be continuous or discrete. A matching engine computes the match scores for market transactions based on a predetermined evaluation method specified via the administrator interface and based on a unique match score computation method.--

REMARKS

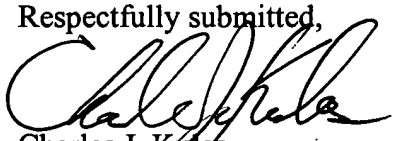
The undersigned, who is admitted to practice before the U.S. Patent and Trademark Office, verifies that the Substitute Specification and Amended Abstract contain no new matter.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 415-576-0200.

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE TO THE CLAIMS

13. (Amended) The system of Claim 12 wherein said matching engine includes software for computing a total match score (Z_{ij}) according to said match score computation method based on said importance values according to the following equation:

$$Z_{ij} = \sqrt{Z_{ij}^{i} Z_{ij}^{j}} ,$$

where Z_{ij}^{i} is a match score based on importance values assigned by a first participant in said electronic market and any corresponding **preference** numbers D_{ijr}, and Z_{ij}^{j} is a match score based on importance values associated with a second participant in said market and any corresponding **preference** numbers D_{ijr}.

VERSION WITH MARKINGS TO SHOW CHANGES MADE TO ABSTRACT

ABSTRACT OF THE DISCLOSURE

An efficient system for implementing an electronic market. The system includes a first mechanism for defining a set of attributes and associated descriptor variables involved in market transactions. Importance values are assigned to the descriptor variables by the first mechanism. A second mechanism computes match scores for the market transactions based on the importance values **and on the quality of the matches on any number of specific attributes that form the components of the aggregate match score. The aggregate match score is based on one or multiple parties' assessment of attribute importance. Thus, a good match is one that is liked by both (or many) sides of transactions**. A third mechanism employs the match scores to clear the electronic market. In the specific embodiment, the first mechanism includes an administrator interface, which allows an administrator to define the descriptor variables. A configurator communicates with the administrator interface and allows the administrator to assign a first set importance values to corresponding descriptor variables. The first set importance values includes default importance values or importance values assigned to the descriptor variables by a seller seeking to transact with a buyer via the electronic market. The administrator interface allows an administrator to configure a user interface of the market to allow market participants to assign a second set of importance values to different descriptor variables. The second set of importance values includes buyer and seller importance values. The descriptor variables and associated descriptor importance values may be continuous or discrete. A matching engine computes the match scores for market transactions based on a predetermined evaluation method specified via the administrator interface and based on a unique match score computation method.

MARKED-UP VERSION OF SPECIFICATION

Attorney Docket No.: 20512-000120US

SYSTEM AND METHOD FOR IMPLEMENTING ELECTRONIC MARKETS

CLAIM OF PRIORITY

This application claims priority from U.S. Provisional Patent Application No. 60/193,955, filed March 31, 2000, entitled "Electronic Commerce System Including Weighted Characteristic Matching, Dynamic And Automated Creation Of Markets, Analysis Tools And Administrator Interface" which is hereby incorporated by reference as if set forth in full in this document.

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is related to co-pending Patent Application No. [TBA], filed March 30, 2001, entitled "Electronic Matching Engine For Matching Desired Characteristics With Item Attributes" (Attorney Docket 20512-1-1) and Patent Application No. [TBA], filed March 30, 2001 entitled "Efficient Interface For Configuring An Electronic Market." (Attorney Docket 20512-1-3).

BACKGROUND OF THE INVENTION

Field of Invention:

This invention relates in general to electronic transactions using digital processing systems, and more specifically to a system for creating and operating electronic marketplaces.

Description of the Related Art:

Electronic commerce systems are becoming popular as a way for people to purchase or trade goods and services. Such systems often take the form of "stores" where a buyer can purchase a good, or "auctions" where a bidder can attempt to purchase an item by progressive bidding. The Internet provides an effective network to allow users, or buyers, to

participate in electronic markets by using electronic commerce systems. Examples of such systems are at www.amazon.com or www.ebay.com.

Although such sites are effective in allowing a user to bid on, or directly purchase, items they are not without shortcomings. Because of the sheer number of items available, it is often difficult for a user to identify a desired item. Rudimentary search engines are typically provided by such sites. However, such search engines are restrictive in the types of queries that can be made and the results that are returned. Also, each system is set up to be a specific type of market. It is difficult, for example, to turn a direct purchase system into an auction system. The type of market must be decided upon from the beginning of the design of the system. Many months are usually needed to program, test and deploy the system. Once deployed, such systems are difficult to adapt to changing market needs. Also, the variety of markets that are provided by today's systems is very limited. These limitations are due, in part, to the searching, or matching, engines that perform the task of matching an item for sale with a set of characteristics desired by a buyer.

There are already a large number of electronic markets that have been conceived, but cannot be implemented because current engines are not able to deal with necessary intricacies. Many such markets involve services, where description of the item to be traded needs to be so detailed that the categories may lack any buyers or sellers who satisfy the criteria.

For example, services (as opposed to goods) are difficult to trade electronically because individuals who provide the services are heterogeneous. Unlike office supplies, workers are idiosyncratic, possessing different skills, having different experience, and wanting different characteristics in jobs that they are willing to take. Other engines deal with these idiosyncrasies in a rigid manner that lumps different people into the same category.

Current engines do not handle substitution between goods. For example, consider the market for a used car. A buyer is asked to specify the desired characteristics of a car. These include make, model, year, and possibly color. As the category narrows, fewer cars are presented to the potential buyer. At the end of the process, all cars within the desired category are listed as if they are perfect substitutes for one another. Those outside the category are not listed at all. But a buyer might prefer 1998 Honda Accord to a 1997 Toyota Camry at the same price. **If the buyer had already specified "Toyota" or "1997", the Honda Accord would be missed. Furthermore, if the buyer simply specified "small car, late 90s" far too many matches would be presented.** Current matching methods [ignore

these possibilities] **are unable to turn this situation into one that has better user applicability**.

Current engines also do not provide mechanisms to value certain characteristics over others. Usually a buyer must provide the characteristics for use in a match. Provided characteristics must be present or there is no match. Characteristics that may not be very important to the buyer are treated the same as characteristics that the buyer deems essential.

Additionally, a good match to one party is not necessarily a good match to another. For example, there may be 100 jobs that a particular job applicant would like, but there might be only 4 out of that 100 that would think about hiring the worker into the position. It is much more useful to the applicant if he is presented only with matches that will end up being relevant to him.

Often a market administrator is in a position to set up a market type but is unsure, or ignorant, of the market type that would be most efficient. Traditional systems do not provide insight into the effects of using a particular market type for a particular commerce application.

SUMMARY OF THE INVENTION

The present invention allows an administrator to create, run, model and adapt an electronic commerce system so that the system operates more efficiently. Many possible types of electronic markets can be created and managed. The system assists administrators in selecting the appropriate market and in improving the performance of an operating market.

In the illustrative embodiment, the inventive system is adapted for use with the Internet. The system includes a first mechanism for defining a set of attributes and associated descriptor variables involved in market transactions and assigning importance values to the descriptor variables. A second mechanism computes match scores for the market transactions based on the importance values. A third mechanism clears the electronic market in accordance with the match scores.

In a more specific embodiment, the first mechanism includes an administrator interface for allowing an administrator to define the descriptor variables. A configurator communicates with the administrator interface allowing the administrator to assign a first set of one or more importance values to one or more of the descriptor variables, respectively. The first set of one or more importance values includes default importance values or

importance values assigned to the descriptor variables by a seller seeking to transact with a buyer via the electronic market.

The administrator interface includes a mechanism for configuring a user interface of the market to allow a participant in a market transaction to assign a second set of one or more of the importance values to the descriptor variables. The second set of one or more importance values includes buyer importance values assigned to the descriptor variables by a buyer seeking to transact with a seller via the electronic market. The descriptor variables and associated descriptor importance values may be continuous or discrete.

The second mechanism includes a matching engine for computing the match scores for market transactions based on a predetermined evaluation method specified via the administrator interface and based on a match score computation method. The predetermined evaluation method includes a mechanism for mapping descriptor values into corresponding [preference] numbers (D_{ijr}) within a predetermined number range, such as between 0 and 1. The predetermined evaluation method includes a more is better method **(where higher valued continuous variables receive a higher score)**, an equal to method **(as in the case of Boolean operators or for continuous variables where a real value is equal to another real value)**, a less is better method **(opposite of more is better)**, and a distance method **(where value, but not sign is important)**, among others. The (D_{ijr}) variables can be computed from underlying raw data that can take the form of numerical or alphbetical descriptors. One innovation is allowing any type of data to be transformed into real numbers (often between zero and one). For example, a consumer preferring that something be made of nylon might receive a score of .6 (rather than one or zero) for something made of rayon or other related synthetic material. Software running on the matching engine uses the match score computation method to compute a total match score (Z_{ij}) based on the importance values according to the following equation:

$$Z_{ij} = \sqrt{Z_{ij}^{i} Z_{ij}^{j}} ,$$

where Z_{ij}^{i} is a match score based on importance values assigned by a first participant in the electronic market and any corresponding preference numbers D_{ijr}, and Z_{ij}^{j} is a match score based on importance values associated with a second participant in the market and any corresponding preference numbers. (D_{ijr} The functional form that relates the total score need

not be a square root, but can be any function of the two underlying components Z_{ij} and Z_{ij}).[.)

] In the specific embodiment, the first participant is a seller and the second participant is a buyer. The third mechanism includes one-to-many market-clearing software and/or [one-]**many**-to-[one] **many** market-clearing software. The [one-]**many**-to-[one] **many** market-clearing software includes a mechanism for searching all total match scores Z_{ij} for market participants i and j (seller i and buyer j); selecting [the maximum] **a particular** value of Z_{ij}; matching participant i to participant j to yield cleared participants in response thereto; removing Z_{ij} corresponding to the cleared participants from the set of all Z_{ij} to yield a reduced Z_{ij}; and repeating the above steps for the reduced Z_{ij} **matrix**. The [one-]**many**-to-[one] **many** market-clearing software further includes a mechanism for clearing markets that maximizes the sum of all matches Z_{ij} and clears sections of a matrix of values corresponding to Z_{ij}.

The third mechanism includes an endogenous market definer that automatically defines the descriptor variables based on pre-existing market data. The third mechanism further includes a semi-endogenous market definer that selects a starting seller to participate in market transactions. The starting seller is chosen to match best with all buyers participating in the electronic market.

An electronic market implemented via the system of the present invention may be an internal allocation market, a business-to-business concierge, a modified competitive market, an electronic pawn shop, an electronic wholesaler, a trading post, an auction or qualified auction, a web credit market, and so on.

The novel design of the present invention is facilitated by the first means, which enables attributes of transaction entities, such as products or services, to be ranked in order of importance. Scores for transactions may be computed by ranking the importance of particular attributes. Consequently, buyer and seller desires are accurately modeled and used to optimally match transactions.

By employing continuous and/or discrete descriptor variables rather than discrete descriptor variables only, the present invention allows users to specify relative preferences between attributes. For example, a user may indicate that car safety features are more important than color by assigning a lower importance value to the car safety features

attribute(s) than for the color attribute. Conventionally, a user could only specify whether they wanted a car with the safety attributes and/or the indicated color attribute or not.

Additionally, preference variables can be specified in a continuous fashion. For example, a basketball team might specify that it prefers a guard who is 6'4" tall would not be ruled out automatically, but would received a lower rating than a player who was 6'3" tall.

Unlike with conventional categorical markets, the probability of successfully recommending a product based on customer preferences does not decrease as possible specified categories increase. Consequently, the present invention enables implementation of certain market types that would otherwise be impossible to electronically implement via conventional categorical matching engines.

The present invention provides multi-attribute search and transaction matching capabilities with a controlled number of matches and employs a matching algorithm that can process fuzzy or vague descriptions of desired products. The matching algorithm can recommend products when a perfect match is not found and may accommodate different buyer and seller attribute preferences. Markets implemented via the present invention may recommend high-margin products when a customer is indifferent between two or more products. The matching algorithm is quick and efficient, reducing average search time to [under a minute] **a fraction of a second for small problems (including one to very many) and to minutes for extremely large many-to-many searches (e.g., assigning 10,000 consultants to 10,000 clients)**. Markets incorporating the present invention can handle any number of attributes while always returning a match or recommendation.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram of a customizable matching system for implementing an electronic market constructed in accordance with the teachings of the present invention.

Fig. 2 is flow diagram of a method used by the customizable matching system of Fig. 1 to implement an electronic market.

DESCRIPTION OF THE INVENTION

Fig. 1 is a diagram of a customizable matching system 10 constructed in accordance with the teachings of the present invention. For clarity, various components of the matching system 10, such as operating systems, modems, and power supplies are not

shown in Fig. 1, however these components are well known and readily implemented by those skilled in the art.

The matching system 10 generates e-commerce markets and internal allocation markets by efficiently matching buyers and sellers, matching buyers to products, and/or matching internal tasks to employees, and so on, in accordance with the type(s) of market implemented by the matching system 10. For the purposes of the present discussion, the term market is defined as any system for matching or qualifying two or more entities in a transaction. This includes internal allocation systems. A market is typically associated with a physical or virtual location where entities, such as buyers and sellers, come together to sell or exchange goods and/or services. Furthermore, in the present discussion, the terms market and market configuration are used interchangeably. The market configuration represents a computer file (or other memory mechanism) with instructions and data for implementing an electronic market.

The matching system 10 includes a market generation system 12 in communication with system and market administrators 14 and a client computer 16. The client computer 16 communicates with a user community 18, which may include buyers and sellers, via the Internet 20.

The market generation system 12 includes a market configurator 22 having an administrator interface 24, a configuration database 26, a matching engine 28, and a transaction database 30. The administrator interface 24 enables market administrators 14 to quickly configure the matching system 10 to meet changing market demands.

The administrator interface 24 facilitates creating an e-commerce user interface implemented via the website 36. The administrator interface 24 has instructions (including administrator instructions and corresponding implementation software) and input fields for facilitating market type definition. The administrator interface 24 also includes instructions and input fields allowing the administrators 14 to define characteristics associated with entities to be transacted via a market, such as products or services.

The configurator 22 outputs configuration data to an application server 32 residing on the client computer 16. The configurator 22 also communicates with the configuration database 26, which provides input to a matching engine 28. The matching engine 28 provides intelligence input to the configurator 22 and communicates with the transaction database 30 and the application server 32 running on the client computer 16.

The client computer 16 has a web server 34 and a central database 38, which communicate with the application server 32. The web server 34 hosts e-commerce websites 38, which are accessible to the online user community 18 via the Internet 20.

In operation, a company or other organization wishing to use the matching system 10 to generate an e-commerce market provides the market administrators 14 with a clearly defined business model. Such a company is called a net market maker, which is an entity that creates an Internet market to match buyers and sellers. The net market maker does not necessarily own goods.

The administrators 14 input market configuration information to the configurator 22 via the administrator interface 24 in accordance with the selected business model. The market configuration information includes the name and type of market to be configured, which administrators and groups thereof will have access to configure the market, and market behavior information. Market behavior information includes criteria used to match products and/or services to buyers or to match buyers and sellers, the types of transactions used, attributes of goods and/or services to be associated with preferences, importance values (weights) associated with the preferences, whether the preferences will be associated with discrete or continuous attribute variables, and so on, as discussed more fully below.

The configurator 22 allows administrators 14 to set up a market and configure the user interfaces 36 simultaneously. Through a series of drop-down menus and questions, the administrators 14 are guided through the process of setting up the particular market. Administrator input affects operation of the overall matching system 10, including which modules are employed therein, and generates simple user interfaces 36 incorporating user-friendly questionnaires (not shown). The simple and efficient user interfaces 36 make the underlying market generation system 12 and computer 16 transparent to the users.

The configurator 22 is completely customizable so that the administrators 14 can define any number or type of market descriptor variables. The configurator 22 translates this information automatically into a form that is usable by the matching engine 28 and application server 32. The configurator 22 automatically handles complex technical issues associated with generating the e-commerce site 36 and requires only simple input from the administrators 14. The administrators 14 may only be required to complete eight or fewer panels.

Additional details of the administrator interface 24 are discussed more fully in co-pending U.S. Patent Application No. {TBA], filed March 30, 2001, by A. Arora, et al.,

entitled, "Efficient Interface For Configuring An Electronic Market," (Attorney Docket No. 20512-000130US), assigned to the assignee of the present invention and incorporated by reference herein.

Market configuration information that is input via the administrator interface 24 of the configuration 22 is stored in the configuration database 26. The configuration database 26 also stores configuration information for previously created markets, which enables the administrators 14 to selectively copy configuration information from pre-configured markets to expedite market implementation.

In the present specific embodiment, the configuration information that is provided by the market administrators 14 to the configurator 22 via the administrator interface 24 is sent to the application server 32 on the client computer 16 as an XML (Extensible Mark-up Language) file (config.xml) via HTTP (Hypertext Transfer Protocol) protocol. Use of XML files enhances the portability of the market generation system 12, facilitating interfacing with different client computers running different types of application servers, web servers, and operating systems.

The administrators 14 may selectively activate and deactivate markets. When a configured market is activated, the market configuration information is provided to the application server 32 running on the client computer 16. The matching engine 28 receives configuration information from the configuration database 26. In an active market, configuration information is available to the websites 36 so that buyers and sellers 18 can input data. In an inactive market, market configuration is unavailable to the front end, i.e., websites 36 so that users, such as buyers and sellers, cannot enter data.

The application server 32 runs software for generating and configuring the user interfaces of the websites 36 according to market configuration information (config.xml) received from the configurator 22. The configuration information specifies user interface details, such as what preferences selections for what products or services will be available to the users 18 and how the preferences will be selected by the users 18, such as by drop down lists or text fields.

The application server 32 may perform tasks other than user interface generation and configuration without departing from the scope of the present invention. For example, some matching engine computations may be distributed to the application server 32.

When the users 18 participate in the market, they input their preferences via the website user interfaces 36 by associating importance values with desired attributes associated with entities to be transacted via the current transaction. Their preferences and

selections are forwarded to the matching engine 28 via the application server 32. The matching engine 28 performs matching between entities involved in market transactions, such as buyers and sellers, while accounting for buyer and seller wishes or preferences. The matching engine 28 transfers XML files via HTTP to and from the application server 32. The XML files transferred to the matching engine 28 from the application server 32 include have.xml and want.xml, which contain information pertaining to buyer and seller preferences and product and/or service availability. XML files transferred to the application server 32 from the matching engine 28 include buyer.xml and seller.xml, which contain matching information specifying which sellers, buyers, products, and/or services are matched.

The matching engine 28 selectively stores and accesses transaction information on the transaction database 30. The transaction database 30 maintains transaction records, which facilitate market-clearing operations. The administrators 14 may employ the administrator interface 24 to direct the matching engine 28 to clear a market.

The matching engine 28 employs the configuration information to match buyers and sellers, buyers with products or services, or workers with tasks, and so on, according to the configuration information, which may include pre-selected matching techniques. The matching engine 28 receives information pertaining to importance weights assigned to desired attributes by buyers and sellers from the application server 32. The matching engine 28 then searches the transaction database 30 or central database 38 to find and score combinations of buyers and sellers or buyers and products, or workers and job assignments, and so on. The match score computed by the matching engine 28 is based on the importance weights assigned by market participants, such as buyers and sellers. A predetermined number of matches associated with the highest match scores are displayed to the users 18 via the interfaces 36.

For example, a customer searching for a car may specify desired attributes, such as red car, airbag, snow tires, and so on. The customer may assign importance values, such as 0.5, 0.7, and 0.4, respectively, to the desired attributes. This indicates that the customer values airbag safety attributes more than a red paint job and values the red paint job more than snow tires. The match engine 28 then searches a market database, such as the central database 38 that contains information pertaining to cars for sale and their corresponding attributes. The information pertaining to cars for sale may also include information indicating seller preferences. For example, a seller may prefer to sell a car with a high profit margin rather than a car with a low profit margin. The matching engine 28 searches the appropriate database and scores each car based on importance values assigned

to the automobile search by the customer and the importance values assigned by the seller. The matching engine 28 then returns match information to the customer, which includes a list of cars that most closely accommodate the customer's preferences (highest match scores) and any seller preferences as indicated by assigned importance weights.

The matching engine 28 of the present invention may accommodate discrete and continuous weights assigned to entities to be transacted. The weights, which are also called importance values, are assigned to attributes (of entities to be transacted) by buyers, sellers, administrators, or other market participants. The matching engine 28 computes a score for a match based on the weights. The exact details of the method for computing the matching score are application-specific and may vary. One skilled in the art with access to the present teachings may easily adapt the methods disclosed herein to accommodate the needs of a given application.

The matching engine 18 may be employed to recommend an optimal market for a given combination of goods and services based on previous transaction information stored in the transaction database 30 and based on intelligence algorithms running on the matching engine 28. These intelligence algorithms may also be employed to perform predictive simulations in accordance with varying parameters as set via the administrator interface 24. Furthermore, these software algorithms may be employed to endogenously define a market based on predetermined criteria. When the market generation system 12 endogenously defines a market, the market is automatically configured to meet the needs of a given market place. The market administrators 14 are then freed from various market design and configuration tasks.

In the preferred embodiment, the matching engine 28 computes a matching score (Z_{ij}) according to the following equation:

$$Z_{ij} = \sqrt{Z_{ij}^{i} Z_{ij}^{j}}\,, \qquad [1]$$

where Z_{ij}^{i} and Z_{ij}^{j} are defined similarly according to the following equation:

$$Z_{ij}^{i} = \sqrt{\left[\prod_{r}\left(1-a_{ir}\left(1-D_{ijr}\right)\right)\right]^{\frac{1}{R}}\left[\sum_{r}\delta_{ir}\left(1-a_{ir}\left(1-D_{ijr}\right)\right)\right]}\,, \qquad [2]$$

where R is the total number of attributes of index r considered; a_{ir} is an importance value that the i^{th} seller attaches to the r^{th} attribute; **and** $\delta_{ir} = \frac{a_{i_r}}{\sum_r a_{i_r}}$ **, i.e., the normalized importance of attribute r to agent i**. The r^{th} attribute that is associated with the i^{th} seller is associated with an attribute variable x_{ir}. When computing Z_{ij}^{j} for buyers, a_{jr} is an importance value that the j^{th} buyer attaches to the r^{th} attribute. The r^{th} attribute associated with the j^{th} buyer is assigned an attribute variable x_{jr}. D_{ijr} is a [preference variable with] **a transformation of the raw attribute data. It tells the closeness of the match between i and j on attribute r, normalized usually to take** a value between zero and one that changes in accordance with how well a seller's desires are satisfied by a buyer's characteristics of vice versa. D_{ijr} [is given by one of the following equations] **can take any number of forms. A few are shown here**:

$$D_{ijr} = \max\left[0, \left(1 - \frac{C_{ijr}}{C_r^{\max}}\right)\right], \text{ or} \qquad [3]$$

$$D_{ijr} = \frac{e^{(1.946(x_{ir} - x_{jr})/\sigma_r)}}{1 + e^{(1.946(x_{ir} - x_{jr})/\sigma_r)}}, \text{ or} \qquad [4]$$

$$D_{ijr} = \{0,1\}, \qquad [5]$$

where the factor 1.946 may be changed or set by an administrator; σ_r is the standard deviation of x_{ir} - x_{jr}; C_{ijr} is a non-negative pre-determined value, which may be obtained from a table look-up or other procedure; and $C_r^{\max}$ is the maximum tolerable value for C_{ijr}, is application-specific, and may be determined by one skilled. C_{ijr} may be zero, which is often the best value for C_{ijr}. For example if C_{ijr} is defined as the distance between two locations, where $C_r^{\max}$ is the maximum tolerable distance, all values greater than $C_r^{\max}$ would result in $D_{ijr} = 0$. With access to the present teachings, one skilled in the art may easily determine values for C_{ijr} and $C_r^{\max}$ to meet the needs of a given application.

Alternative forms of D_{ijr} include

$$D_{ij,r} = \max\{0, \min[1, 1 - \frac{|X_{i,r} - X_{j,r}|}{2 \cdot X_{half,r}}]\}$$

$$D_{ij,r} = \max\{0, \min[1, 1 - \frac{1}{2}\left(\frac{X_{i,r} - X_{j,r}}{X_{half,r}}\right)^2]\}$$

and

$$D_{ij,r} = \max\{0, \min[1, 1 - \frac{1}{2}\sqrt{\frac{|X_{i,r} - X_{j,r}|}{X_{half,r}}}]\}$$

The match value, Z_{ij}, as shown in equation (1), [of equation (1)] is a weight mapping function that incorporates pre-selected descriptor value evaluation methods via D_{ijr} and computes a total match score for market participants i and j, such as sellers and buyers, respectively. If a market does not incorporate seller desires, then Z_{ij}^{i} **= 1 in** equation (1) [is not employed and instead,] **and** $Z_{ij} = Z_{ij}^{j}$.

By scoring matches and allowing users, such as buyers, to assign continuous weights to preferred product attributes, users may specify or rank varying degrees of preferences between attributes. Specifying different preference degrees via importance values or weights enables computation of a total score for a match between entities to be involved in a transaction. The total score reflects the compatibility of the entities involved in the match. Matches with the highest score identify entities that are most compatible to transact with each other. By computing a total score for the match, and selecting the match with the best score, situations wherein no matches are returned are eliminated.

The electronic markets implemented via the customizible matching system 10 of the present invention may employ selectively weighted descriptor variables instead of rigid discrete catagories to describe elements to be transacted such as workers, job asignments, buyers, products, sellers, and so on. However, if certain categorizations are desirable for a certain application, the customizable matching system 10 of the present invention may employ categories in combination with weighted descriptor variables. **Indeed, categorical variables are just a special case of the matching formulas. Thus, one can use smooth substitution as well as more rigid, absolute requirements to create the match values in equation (1). The functional forms in equations (1) through (5) accommodates all forms of variables and thus allows categorical structures as a special case.**

In a symmetric exchange market, searched items are scored according to the preferences of both the buyer and seller. Buyer preferences are specified via the user interfaces 36. Seller preferences are often pre-determined by the seller and specified via the administrator interface 24. The match score for a particular transaction incorporates both customer and seller preferences, which are indicated via weights or importance values associated with descriptors only and/or descriptors and descriptor values. A combined score for a particular searched item is computed via one or more predetermined functions, such as a geometric mean or the function of equation (1).

The customizable matching system 10 allows selective ranking of attributes of a given entity to be transacted according to the importance of the attributes to participants in the transaction. This allows markets to score transactions to find and clear the best-matched transactions. Consequently, the customizable matching system 10 of Fig. 1 eliminates primary shortcomings with conventional matching engines and accompanying systems

In previous systems buyers were limited to a few product attribute preference selections, such as color, model, and year. Each preference was associated with a discrete value, such as yes or no. The total score for a match between a product and a buyer's preferences was computed [as either yes or no.] **by aggregating yes/no responses.b** Consequently as the number possible preferences increased, the likelihood of the system returning no matches greatly increased, and accompanying databases became large and impractical. By employing only discrete weights (1 or 0; yes or no) and failing to allow a consumer to rank relative preferences between attributes, conventional matching engines inaccurately modeled the true preferences or desires of the buyers and resulted in systems which were difficult or impractical to implement.

The matching system 10 may include additional modules, such as market/user level personalization modules, pricing modules, and ramp-up modules, without departing from the scope of the present invention. Such modules, and additional details of the matching engine 28, are discussed more fully in an alternative embodiment of the matching system 10 disclosed in co-pending U.S. Patent Application No. [TBA], filed March 30, 2001, by A. Arora, et al., entitled "Electronic Matching Engine For Matching Desired Characteristics With Item Attributes," (Atty. Docket No. 20512-000110US), assigned to the assignee of the present invention and incorporated by reference herein.

The importance weights assigned by buyers to attributes represent either continuous or discrete values and are associated with corresponding continuous or discrete descriptor variables, as predetermined by the market administrator. For the purposes of the present discussion, a discrete variable can take on one of two discrete values or weights, such as 1 or 0, or yes or no. A continuous variable can take on multiple values, called continuous values or weights, over a predetermined range, such as numbers between 0 and 1. A continuous descriptor variable may be assigned a non-discrete weight, such as a number between 1 and 0, to indicate a user-preference level. Continuous descriptor variables are also called analog descriptor variables, and continuous weights are called analog weights.

When an attribute of an item is described by a continuous variable, the present invention may employ a distance method or a more is better method to compute the score of an item. The distance method includes the step of computing the distance between an ideal descriptor value or level associated with a particular product, service, or seller and a true descriptor value or level specified by the buyer. The product, service, or seller associated with the smallest distance is most preferred by the buyer and results in a D_{ijr} that is closest to 1 (see equations (1) through (3)).

The distance (D) between two vectors, such as a desired descriptor vector $\hat{x} = (x_1, x_2, ..., x_{N-1}, x_N)$ and a an actual descriptor vector $\hat{y} = (y_1, y_2, ..., y_{N-1}, y_N)$ is given by the following equation:

$$D = \sqrt{(x_1 - y_1)^2 + (x_1 - y_1)^2 + \cdots + (x_{N-1} - y_{N-1})^2 + (x_N - y_N)^2} \qquad [6]$$

The elements of each vector $\hat{x}$ and $\hat{y}$ represent optimal descriptor weights and actual descriptor weights, respectively, for N corresponding attributes of a particular product or service being searched.